2013

North American Indigenous Adolescent Substance Use

Melissa Walls
University of Minnesota Medical School-Duluth, mlwalls@umn.edu

Kelley J. Sittner Hartshorn
Oklahoma State University, kelley.sittner@okstate.edu

Les B. Whitbeck
University of Nebraska-Lincoln, lwhitbeck2@unl.edu

Published in final edited form as:
Addict Behav. 2013 May ; 38(5): 2103–2109. doi:10.1016/j.addbeh.2013.01.004.

North American Indigenous Adolescent Substance Use*

Melissa Walls, Ph.D.[a], **Kelley Sittner Hartshorn, PhD**[b], and **Les B. Whitbeck, Ph.D.**[c]

Melissa Walls: mlwalls@d.umn.edu; Kelley Sittner Hartshorn: kelley.hartshorn@okstate.edu; Les B. Whitbeck: lwhitbeck2@unl.edu

[a]University of Minnesota Medical School-Duluth 1035 University Drive 235 SMed Duluth, MN 55812 218-726-8367 (telephone) 218-726-7559 (fax)

[b]Oklahoma State University 471 Murray Hall Stillwater, OK 74078-4062 (405) 744-6127 (phone) (405) 744-5780 (fax)

[c]University of Nebraska-Lincoln 711 Oldfather Hall Lincoln, NE 68588-0324 402-472-5562

Abstract

Objectives—To investigate growth in problem drinking and monthly marijuana use among North American Indigenous adolescents from the upper Midwest and Canada.

Methods—Panel data from a community-based participatory research project includes responses from 619 adolescents residing on or near 7 different reservations/reserves. All respondents were members of the same Indigenous cultural group.

Results—Rates of problem drinking and monthly marijuana use increased steadily across the adolescent years, with fastest growth occurring in early adolescence (before age 15). In general, female participants reported higher rates of substance use prior to age 15; however, male reports of use surpassed those of females in later adolescence.

Conclusions—Results of this study highlight the importance of early adolescent substance use prevention efforts and the possible utility of gender responsive programming.

Keywords

American Indian; First Nations; substance use; adolescent substance use

1. Introduction

Understanding patterns and onset of substance use among young people is of significant public health relevance. Earlier onset substance use (before age 14 years) is associated with increased risk for an array of negative outcomes including school troubles, later drug and alcohol abuse, and greater likelihood of adulthood alcohol and mental health disorders and related problems (e.g. Ellickson et al., 2003; Kaplow et al., 2002; Ellickson et al., 2004; Beals, et al., 2005; Henry et al., 2011; McGue et al., 2001). Clearer descriptions of prevalence patterns within particular contexts and populations are imperative for effective, targeted prevention and/or delayed substance use onset. In particular, generalizing patterns of “Native American” substance use is problematic in light of cultural heterogeneity across hundreds of North American tribal groups (Beauvais, 1992). For example, marked

*This project is funded by grants from the National Institute on Drug Abuse (DA 13580) and the National Institute of Mental Health (MH67281), Les B Whitbeck, Principal Investigator. The authors would like to gratefully acknowledge comments received about the manuscript from members of this project’s community advisory boards.

Correspondence to: Melissa Walls, mlwalls@d.umn.edu.

discrepancies in smoking initiation, drinking prevalence, and other drug use have been found between Southwest and Northern Plains tribal groups and in regional comparisons across the United States (Henderson, et al., 2009; O'Connell, Novins, Beals & Spicer, 2005; Plunkett & Mitchell, 2000; Novins & Mitchell, 1998). The purpose of this paper is to examine changes in problem drinking (operationalized as 5 or more drinks in one sitting) and monthly marijuana use among North American Indigenous adolescents from the upper Midwest and Canada. This is the only panel study of which we are aware that follows a population sample of reservation/reserve residing American Indian and First Nations children through the critical period of late childhood into early adulthood (i.e., ages 10 – 18 years).

The historical and ongoing assaults on Indigenous North Americans (i.e., American Indian/First Nations members) position them in a "fourth world" context (Walters et al., 2002; Walters & Simoni, 2002) and can be seen as key determinants of contemporary health disparities (Frank et al., 2000; Walls & Whitbeck, 2011). Today, most reservation communities survive in states of severe economic depravation, underfunded health and human service systems, and ongoing intergenerational traumas that contribute to disparate health outcomes (Braveheart, 1999; Gregory et al., 1996; Robideaux, 2005). In the case of substance use and abuse disparities, decades of research have provided us with important empirical insights. For instance, a majority of Indigenous adults abstain from alcohol use and do so more frequently than the general population (Substance Abuse and Mental Health Services Administration, 2010). May (1994) reported wide variation in substance use prevalence rates in tribal-specific studies, noting that several found lower alcohol use (particularly among women), greater abstinence, and complete remission relative to non-Indigenous adult. Further, one-third of young Indigenous people reported *no* alcohol use over a 3-year period in a study by Mitchell and colleagues (2008). Such evidence does much to dispel the stereotypical myth of the "drunken Indian" (May, 1994).

These compelling illustrations of Indigenous resilience in the face of social and political disadvantage are met simultaneously by more severe substance use-related consequences and higher abuse rates among many of those who do engage in substance use (May & Gossage, 2001). Alcohol-attributable deaths among American Indians and Alaska Natives in the United States have been estimated at twice that of the general population, with Indigenous North Americans losing over 6 more years of potential life per alcohol-related death than their non-Native counterparts (Center for Disease Control and Prevention, 2008). Given the consequences of early substance use, reports that Indigenous youth may be more likely than other young people to engage in early-onset (May, 1982; Miller et al., 2008) and non-experimental substance use (Herring, 1994) are especially troublesome. Further, Whitesell and colleagues (2007) reported increasing risk of marijuana initiation in younger cohorts of American Indians compared to a national sample. In sum, these findings suggest potentially heightened risk for young Indigenous people to experience the consequences of early and more frequent substance use, thus underscoring the public health significance of epidemiological and translational research in this area.

2. Methods

These data were collected as part of a longitudinal study designed in partnership with eight reservations and reserves and a university-based research team (additional relevant publications from this study include (REMOVED FOR BLIND REVIEW)). The overall goal of the project was to collect data on adolescent development and mental health taking into account culturally specific risk and protective factors. Data from seven of the eight participating communities are included in this paper (one of the partners was in the process of rebuilding a community advisory board at the time this paper was written and we chose to

exclude their data in order to honor community rights to review papers prior to publication). The communities share a common cultural tradition and language with minor variations in dialects. As part of this partnership's confidentiality agreements, the names of the cultural group and communities are not identified. At each site, Tribal Council-appointed advisory boards were responsible for handling personnel difficulties, advising the research team on questionnaire development, and reviewing/approving reports and presentation proposals. All participating staff on the reservations and reserves (i.e., interviewers, site coordinators) were approved by advisory boards and were either enrolled tribal members or spouses of enrollees. Interviewers for this project were trained concerning methodological guidelines of personal interviewing and all were certified for work with human subjects.

Each community provided us a list of families of tribally enrolled children aged 10–12 years who lived on or proximate to (within 50 miles) the reservation or reserve. We attempted to contact all families with a target child within the specified age range in order to achieve a population sample. Families for this study were recruited through personal interviewer visits during which they were presented a traditional gift, an overview of the project, and an invitation to participate. Families were chosen for visits if at least one child in the house was between the ages of 10 and 12 years and was tribally enrolled. For those families who agreed to participate, both the study adolescent and at least one adult caretaker (and in some cases, two adults) were given $40 upon completion of the interviews. Recruitment and incentive procedures were approved both by community-based advisory boards and the university IRB. For the seven communities included in this paper, our sampling and recruitment strategy resulted in a 75% response rate and subsequent retention rates of 95%, 93%, 88%, 90%, 88%, and 84% for waves 2 –7, respectively.

This paper includes youth self-report data from the first seven waves of the study collected between 2002 and 2008. At Wave 1, target adolescents were between 10 and 13 years of age with a mean age of 11 years (13-year-olds are those youth who experienced birthdays between recruitment and interview dates). There were 675 children interviewed at Wave 1. Only those adolescents for whom we had at least three observations were included in this analysis. Twenty-eight adolescents had two or fewer observations and thus were excluded. Twenty-eight additional adolescents had missing values on variables included in the between-person level of analysis (level 2) and were excluded. The final sample size for the present study is 619 adolescents, with 2,863 total person-observations (within persons at level 1). Missing data analysis revealed no significant differences between the 56 adolescents who were excluded due to missing data and those who were included.

2.1 Measures

2.1.1 Dependent variables—*Problem drinking* was measured at waves 1, 2, 3, 5, and 7 by asking adolescents whether they have had five or more alcoholic drinks in one sitting in the past year (Waves 4 and 6 were diagnostic waves in which different questions were asked). They were first asked whether they had ever had a drink of beer, wine, or liquor, with each can, bottle, or mixed drink/shot defined as one drink. Those who responded "yes" were then asked if they had drank alcohol in the past 12 months, and if they had, they were then asked if they had consumed five or more drinks at one time. Responses of yes were coded as 1. Responses of never drinking or not having five or more drinks were coded as 0. Distributions of problem drinking by gender and age are displayed in Table 1.

Monthly marijuana use was measured at waves 1, 2, 3, 5, and 7 by asking adolescents a series of questions to identify whether they used marijuana monthly or more often. They were first asked whether they had ever used marijuana. Those who responded "yes" were then asked if they had used it in the past 12 months, and if they had, they were then asked how often in the past 12 months they had used marijuana. Responses of monthly or more

often were coded as 1. Responses of never using marijuana or using it less than monthly were coded as 0. Distributions of monthly or more marijuana use by gender and age are displayed in Figure 2.

2.1.2 Time-invariant covariates (Level 2)—Three control variables from the first wave of data collection were included as stable, time-invariant characteristics. *Gender* is coded so that 1=female, 0=male. *Per capita family income* is a continuous parent/caretaker report of family income, divided by the number of people living within the household, and then divided by 1,000 to set the metric in thousands of dollars. Although all of the communities included in this study can be seen as rural, some of the Canadian reserves in particular are located in isolated, difficult to reach areas. *Remote location* is dichotomized, coded as 1=remote, isolated communities, 0=all other communities.

3. Analytic Strategy

This paper employs piecewise hierarchical generalized linear models (HGLM) to estimate changes in the odds of two types of substance use (i.e., problem drinking and monthly marijuana use) over time. This type of model is appropriate for three reasons. One, HGLMs accommodate dichotomous dependent variables. HGLM uses a penalized-quasi likelihood (PQL) estimation technique (or, Generalized Estimating Equations estimator) for binary non-linear models (Raudenbush & Bryk, 2002). Two, piecewise models allow for the comparison of growth rates during two different periods. Because a primary goal of the present analysis was to compare growth in substance use during early and later adolescence, age 15 was selected as the transition point for the two pieces, or growth trajectories*. Three, the multilevel framework adjusts for the lack of independence among the observations clustered within individuals over time, allows for missing observations at some time points, and does not require participants to have equal numbers of observations (Luke, 2004).

Level 1 of the model examines variability in individuals, that is, how the odds of each type of substance use change over time. Level 2 examines how stable individual characteristics (i.e., gender, per capita family income, remote location) influence Indigenous adolescents' initial (i.e., intercept) odds of substance use as well as growth (i.e., slope) in substance use. Per capita family income, the only continuous variable, is grand-mean centered. We estimated one random effect for the intercept.

In HGLM, the level 1 variance (R_{ij}) = P (1-P_j) is a function of the mean and is not a free parameter for estimation. This is different than multilevel models with continuous outcomes, in which the level 1 variance is estimated. The dependent variable is transformed with a logit link function for the estimation; therefore the outcome is the linearized log odds of substance use type (Lee & Nelder, 1996). Following Diaz (2007), we evaluate the population-average coefficients with robust standard errors.

The baseline models are summarized in the following equation with only an intercept and error term:

$$\begin{gathered}\text{Prob}(\text{Type of substance use}=1|\pi)=P\\ \text{Log}[P/(1-P)]=\pi_{00}+r_0\\ \text{level 1 variance}=1/[P(1-P)]\end{gathered}$$

*Age was coded in two ways for the analysis, with the transition point at age 15. For the first growth term, Age1t, age10=0, age11=1, age12=2, age13=3, age14=4, age15=5, age16=5, age17=5, and age18=5. For the second growth term, Age_{2t}, age10=0, age11=0, age12=0, age13=0, age14=0, age15=0, age16=1, age17=2, and age18=3. The predicted status at each age would be π_0, $\pi_0 + \pi_1$, $\pi_0 + 2\pi_1$, $\pi_0 + 3\pi_1$, $\pi_0 + 4\pi_1$, $\pi_0 + 5\pi_1$, $\pi_0 + 5\pi_1 + \pi_2$, $\pi_0 + 5\pi_1 + 2\pi_2$, $\pi_0 + 5\pi_1 + 3\pi_2$.

The error term for the intercept, r_0, gives an estimate of the variance in odds of substance use (i.e., problem drinking and monthly marijuana use) between adolescents. These coefficients provide information about the effects of stable adolescent characteristics (i.e., level 2 control variables) on substance use risk, adjusting for the lack of independence introduced by observations nested within individuals (Luke, 2004; Snijders & Bosker, 1999; Hox, 2002).

We first evaluated unconditional growth models for problem drinking and monthly marijuana use (Models 1a and 1b, Table 2) using the following equations:

$$\textbf{Level 1}: \quad \mathrm{Log}[P/(1-P)]=\pi_{0j}+\pi_{1j}*(\mathrm{Age}_{1t})+\pi_{2j}*(\mathrm{Age}_{2t})$$
$$\textbf{Level 2}: \quad \text{Initial log odds } \pi_0=\beta_{00}+r_{0j}$$
$$\text{Growth trajectory before age 15 } \pi_1=\beta_{10}$$
$$\text{Growth trajectory after age 15 } \pi_2=\beta_{20}$$

Age was included as the growth term, coded following the two-rate model described in Raudenbush and Bryk (2002, p. 179). In the level 2 equations, β_{00} indicates the odds of each type of substance use at age 10. The first growth term, β_{10}, indicates the rate of growth in substance use for each year past age 10 through age 15. The second growth term, β_{10}, indicates the rate of growth in substance use for each year past age 15 through age 18. In Model 2, we include the control variables at level 2 as cross-level interactions. Model 2 evaluates the relationship between these variables and odds of substance use, specifically whether each is associated with the initial odds of substance use and/or modifies the growth trajectories.

The equation for the full models (Models 2a and 2b, Table 2) is as follows:

$$\textbf{Level 1}: \quad \mathrm{Log}[P/(1-P)]=\pi_{0j}+\pi_{1j}*(\mathrm{Age}_{1t})+\pi_{2j}*(\mathrm{Age}_{2t})$$
$$\textbf{Level 2}: \quad \text{Initial log odds } \pi_0=\beta_{00}+\beta_{01}(\text{female})_j+\beta_{02}(\text{per capita income})_j+\beta_{03}(\text{remote location})_j+r_{0j}$$
$$\text{Growth trajectory before age 15 } \pi_1=\beta_{10}+\beta_{11}(\text{female})_j+\beta_{12}(\text{per capita income})_j+\beta_{13}(\text{remote location})_j$$
$$\text{Growth trajectory after age 15 } \pi_2=\beta_{20}+\beta_{21}(\text{female})_j+\beta_{22}(\text{per capita income})_j+\beta_{23}(\text{remote location})_j$$

4. Results

Equal numbers of male and female adolescents (50% each) participated in this study. Ten percent of the adolescents lived in a remote geographical location. The mean per capita income at wave 1 for these families was $5,505.00.

Table 1 illustrates problem drinking and monthly marijuana use across waves. Our sampling procedure targeted 10 – 12 year old youths at Wave 1; thus, we have organized the substance use prevalence statistics by cohort, or age at study entry. As can be seen, very few of the 10 and 11 year olds reported problem drinking or recent marijuana use at Wave 1 (fewer than 2% across cohorts and genders). For all age cohorts, substance use rates increased steadily across the adolescent years. Problem drinking peaked at about 61% for males and 49% for females at Wave 7 (18 years of age for this cohort), while the highest rates of monthly marijuana use were reported among the Wave 7 17-year-old females (26.3%) and Wave 7 18-year old males (34.8%).

4.1 Trajectories of Problem Drinking

We began the multivariate analyses by estimating an unconditional growth model of problem drinking (Model 1, Table 2). The significant random effect indicates that significant

variation exists in problem drinking at age 10. The odds of problem drinking at age 10 were virtually null (OR=.01). The fastest rate of increase occurred prior to age 15. For each year after age 10 through age 15, the odds of problem drinking more than doubled (OR=2.29). For each year past age 15, however, the odds increased by only 25% (OR=1.25).

Stable individual characteristics were included in Model 2. There were no significant differences between males and females' problem drinking at age 10. Remote location was unrelated to initial problem-drinking status. We found a marginally significant ($p = .052$) income effect whereby adolescents with an above-mean family income have lower initial odds of problem drinking. There was no gender difference in the growth prior to age 15, nor did the other variables modify the first growth trajectory. Growth after age 15, however, did differ by gender. The trajectory for girls was flatter, with girls' odds of problem drinking increasing by only 12% per year after age 15 (OR=1.12), compared to 42% per year for boys (OR=1.42).

Figure 1 provides a graphic illustration of growth in problem drinking for males and females. Boys and girls' probability of problem drinking at age 10 was similar, with girls' probabilities bypassing boys' through age 15. Boys had a faster rate of increase in later adolescence. The second growth rate did not differ by per capita family income or remote location.

4.2 Trajectories of Marijuana Use

The same analysis was repeated with monthly or more marijuana use as the dependent variable, starting with an unconditional growth model (Model 1, Table 3). Significant variation existed in monthly marijuana use at age 10, as indicated by the initial status random effect. As with problem drinking, the odds of monthly marijuana use at age 10 were extremely low (OR=0.01). Also like problem drinking, the fastest rate of increase occurred prior to age 15. The odds of monthly marijuana use doubled for each year after age 10 and through age 15 (OR=2.02). Unlike problem drinking, however, the growth trajectory after age 15 was not statistically significant.

In Model 2, the level 2 variables were entered for initial status at age 10 and as modifiers of the two growth rates. Females had higher initial odds and adolescents with above-mean per capita family income had lower initial odds of monthly marijuana use. Females had a slower rate of increase prior to age 15, however. For each year past age 10 through age 15, the odds of monthly marijuana use for girls increased by 86% (OR=1.86), compared to about 121% for boys (OR=2.21). Income and remote location did not modify the first growth trajectory. The second growth rate, after age 15, was not significant. Simple slopes tests showed that the second growth rate was not statistically significant for either boys or girls, although gender did modify the trajectory. As shown in Figure 1, girls had a higher probability of marijuana use through age 15, but their probability decreased after age 15. Boys' probability of marijuana use after age 15, however, continued to increase, although not at a significant rate.

5. Discussion

This paper presents unique information on the initiation and changes in problem alcohol and monthly marijuana use from late childhood into late adolescence/early adulthood for a population sample of reservation and reserve-dwelling Indigenous people. Consistent with national and tribal substance use studies, (Novins & Mitchell, 1998; SAMHSA, 2010; Johnston et al., 2011; Beauvais et al., 2004; Mitchell et al., 2006) descriptive information from our data revealed steadily increasing rates of substance use across the adolescent years. A 2008 general population sample of 12–13 year-olds reported past month marijuana use

rates of 1%, with rates growing to approximately 6% at 14 – 15 years, 13% at 16 – 17 years, and 16.5% among 18 – 25 year-olds (Substance Abuse and Mental Health Services Administration, 2010). A national school-based sample reported similar prevalence rates, with about 8% of 8th-graders (or, about 14 year-olds), 17% of 10th-graders (around 16 years of age) and 21% of 12th-graders (18 years) using marijuana within 30 days of data collection (Johnston et al., 2011). Comparatively, our 13 year olds reported marijuana use at rates of around 10 – 15% (depending on cohort), increasing to around 27% for the oldest cohort (age 18 at wave 7; Table 1). Rates of monthly marijuana use are much higher among the early adolescents involved in our study and parallel trends reported by Beauvais and colleagues who asserted, “Such high (marijuana use) rates would suggest that, on Indian reservations, marijuana use is a normative behavior and that there are few sanctions against use” (2004, p. 498).

Problem alcohol use (5+ drinks in one sitting) among the youth in our sample was also higher than other U.S. national population reports. Although only about 1% of the youngest (10-year-olds) Indigenous participants in our study reported problem alcohol use, rates grew to around 11% among those aged 13 and peaked at 55.3.% among 18-year olds (Table 1). Data from the National Survey on Drug Use and Health provide estimates of “binge” drinking at 1.6% for 12 -13 year olds, 7% for 14 – 15 year olds, 17% for those 16 –17 years of age, and about 35% for 18 – 20 year old adults. The greatest amount of binge drinking occurred between the ages of 21 – 25 at about 47% (SAMHSA, 2010). Overall, the Indigenous adolescents we interviewed displayed rates of problem drinking by about 16 years of age that surpassed peak rates for young adults in the general population. This finding corresponds to other reports of disproportionate alcohol abuse among those Indigenous individuals who do drink (May & Gossage, 2001).

Our piecewise growth curve approach yielded information to suggest that a critical point of intervention for delaying substance onset occurs during the early adolescent years, especially prior to age 15. During that time, the predicted probability of problem drinking or marijuana use at age 10 was virtually zero but increased steadily throughout the early teens. After age 15, substance use continued to rise, but at a much slower rate. Given the fact that our substance use measures focus on *problem* drinking and relatively frequent (monthly) marijuana use, the need to intervene during the precarious pre-teen and early teenage period of development is evident. This is particularly important considering that early-onset users are more likely to problem drink in later adolescence (Cheadle & Whitbeck, 2011) and to meet later criteria for marijuana abuse/dependence (Cheadle & Sittner Hartshorn, 2012).

Although some researchers have found that adult Indigenous women tend to use substances less frequently than men (May, 1994; Cheadle & Whitbeck, 2011) the current analysis shows that the girls in our study were especially at risk for earlier initiation of marijuana use than were boys. Between the ages of 10 and 15, probability of marijuana use was greater for female compared to male participants; however, the expected growth in probability of substance use decreased for girls but continued to increase for boys after the age of 15. In other words, the girls in our study reported more marijuana use during the early adolescent years, but boys’ use rates caught up and eventually bypassed girls’ by late adolescence. A similar trend has been found in more recent general population research in which boys’ greater substance use rates appear to emerge in mid-to-late adolescence, prior to which female rates are higher or gender differences are minimal (Johnston et al., 2006). Substance use patterns by gender among Indigenous youth in other studies have yielded diverse outcomes. In some communities, girls report higher rates of use, (Spear et al., 2005; Costello et al., 1997) in others young males show greater drug and alcohol consumption, (Beauvais, 1992; Neumark-Sztainer et al., 1996; Wallace et al., 2003; Mitchell et al., 1999) and still others report no significant gender differences in substance use progression and/or

prevalence (Novins & Baron, 2004). Such variation further underscores the consistent message relayed by scholars engaged with Indigenous communities (May, 1994; Westermeyer, 1974): “Pan-Indian” or generalized notions of substance use epidemiology are problematic and offer little translational capacity at the local/tribal public health level, whereas the broader impact of culturally specific studies can benefit scientific and theoretical advancement and inform other culturally defined population studies (Beals et al., 2003).

6. Limitations & Future Directions

Inherent strengths of culturally-specific studies for targeted community interventions and translational capacity simultaneously mean that the trends observed here may not be generalizable to other Indigenous cultures or to Indigenous people who live in urban areas. An additional potential limit of this research is our reliance on self-report data, which may be subject to social desirability bias and underreporting (Fendrich & Mackesy-Amiti, 2000; Fendrich et al., 2000). The focus for this paper has been to describe the changes in substance use across adolescence for the Indigenous youth who participated in our study. Additional hypothesis-driven work should explore the potential social, academic, and health-related consequences of substance use at various points throughout adolescent development.

7. Conclusion

This study provides unique data presenting trends in problem drinking and monthly marijuana use that highlight key points regarding timing and approach in public health prevention and delayed onset strategies. First, substance use rates among the Indigenous youth from the culture included in this study clearly and steadily rise from virtually no use at the age of 10 to disproportionately high substance use by the age of 15. The critical period of the early teenage years for intervention efforts within these communities is evident. Second, we document a gender effect in which girls tend to engage in earlier onset and accelerated early-adolescent marijuana use but are bypassed by their male peers in later adolescence (i.e., after the age of 15). A similar accelerated trend in male problem drinking is shown after age 15. Gender-responsive programming that aims to identify the unique experiences of boys and girls during adolescent development may be warranted. We have proposed elsewhere (Removed for Blind Review) that interventions should be early, gender sensitive, and both universal and targeted. Interventions after adolescents begin to experiment with substances in mid-adolescence should be qualitatively different from prevention efforts targeted at early adolescents who have not begun such experimentation. Given the socio-historical context of disempowerment and trauma endured by Indigenous North American communities, public health approaches to substance use prevention should be mindful of the social determinants of contemporary health disparities and promote community member identification of risk and resilience factors salient to specific cultures and reservations/reserves.

References

Beals J, Manson S, Whitesell N, Spicer P, Novins D, Mitchell C. Prevalence of DSM-IV Disorders and Attendant Help-Seeking in 2 American Indian Reservation Populations. Archives of General Psychiatry. 2005; 62:99–108. [PubMed: 15630077]

Beals J, Manson SM, Mitchell CM, Spicer P. Cultural specificity and comparison in psychiatric epidemiology: walking the tightrope in American Indian research. Culture, Medicine, and Psychiatry. 2003; 27:259–289.

Beauvais F. Indian adolescent drug and alcohol use: recent patterns and consequences (special issue). American Indian and Alaska Native Mental Health Research. 1992; 5:1–78. [PubMed: 1420536]

Beauvais F, Jumper-Thurman P, Helm H, Plested B, Burnside M. Surveillance of drug use among American Indian adolescents: patterns over 25 years. Journal of Adolescent Health. 2004; 34:493–500. [PubMed: 15145406]

Braveheart M. The historical trauma response among natives and its relationship with substance abuse: a Lakota illustration. Journal of Psychoactive Drugs. 1999; 35:7–13.

Centers for Disease Control and Prevention. Alcohol-attributable deaths and years of potential life lost among American Indians and Alaska Natives United States, 2001–2005. Morbidity and Mortality Weekly Report. 2008; 57:938–941. [PubMed: 18756193]

Cheadle JE, Sittner Hartshorn K. Patterns of marijuana use amongst northern Midwestern American Indian youth. Social Science Research. 2012; 41:1227–1240. [PubMed: 23017929]

Cheadle JE, Whitbeck L. Alcohol use trajectories and problem drinking over the course of adolescence: a study of North American indigenous youth and their caretakers. Journal of Health and Social Behavior. 2011; 52:228–245. [PubMed: 21558489]

Costello J, Farmer E, Angold A, Burns B, Erkanli A. Psychiatric disorders among American Indian and white youth in Appalachia: The Great Smoky Mountains Study. American Journal of Public Health. 1997; 87:827–832. [PubMed: 9184514]

Diaz RE. Comparison of PQL and Laplace 6 estimates of hierarchical linear models when comparing groups of small incident rates in cluster randomized trials. Computational Statistics and Data Analysis. 2007; 51:2871–2888.

Ellickson PL, Martino SC, Collins RL. RAND. Marijuana use from adolescence to young adulthood: multiple developmental trajectories and their associated outcomes. Health Psychology. 2004; 23:299–307. [PubMed: 15099171]

Ellickson P, Tucker J, Klein D. Ten year prospective study of health problems associated with early drinking. Pediatrics. 2003; 111:949–955. [PubMed: 12728070]

Frank JW, Moore RS, Ames GM. Historical and cultural roots of drinking problems among American Indians. American Journal of Public Health. 2000; 90:344–351. [PubMed: 10705850]

Fendrich M, Johnson T, Wislar J, Hubbell A, Spiehler V. The utility of drug testing in epidemiological research: results from a general population survey. Addiction. 2000; 99:197–208. [PubMed: 14756712]

Fendrich M, Mackesy-Amiti M. Decreased drug reporting in a cross-sectional student drug use survey. Journal of Substance Abuse. 2000; 11:161–172. [PubMed: 10989776]

Gregory, R.; Abello, A.; Johnson, J. The individual and economic well-being of Native American men and women during the 1980s: a decade of moving backwards. In: Sandefur, GD.; Rindfuss, R.; Cohen, B., editors. Changing Numbers, Changing Needs: American Indian Demography and Public Health. Washington, D.C: National Academy of Sciences; 1996. p. 133-171.

Henderson PN, Kanekar S, Wen Y, Buchwald D, Goldberg J, Choi W, Okuyemi K, Ahluwalia J, Henderson J. Patterns of Cigarette Smoking Inititation in Two Culturally Distinct American Indian Tribes. American Journal of Public Health. 2009; 99(1):2020–2025. [PubMed: 19820215]

Henry KL, McDonald JN, Oetting ER, Walker PS, Walker RD, Beauvauis F. Age of onset of first alcohol intoxication and subsequent alcohol use among urban American Indian adolescents. Psychology of Addictive Behaviors. 2011; 25:48–56. [PubMed: 21244122]

Herring R. Substance use among Native American Indian youth: a selected review of causality. Journal of Counseling and Development. 1994; 72:578–584.

Hox, J. Multilevel Analysis: Techniques and Applications. Mahwah, NJ: Lawrence Erlbaum Associates; 2002.

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future National Results on Adolescent Drug Use: Overview of Key Findings. Bethesda, MD: National Institute of Drug Abuse; 2006. NIH Publication No. 06–5882

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future: National Results on Adolescent Drug Use: Overview of Key Findings, 2010. Anne Arbor, MI: Institute for Social Research; 2011.

Kaplow J, Curran P, Dodge K. The Conduct Problems Prevention Research Group. Journal of Abnormal Child Psychology. 2002; 30:199–216. [PubMed: 12041707]

Lee Y, Nelder JA. Hierarchical generalized linear models. Journal of the Royal Statistical Society: Series B (Statistical Methodology). 1996; 58:619–678.

Luke, DA. Multilevel Modeling. Thousand Oaks, CA: Sage Publications; 2004.

May PA. Substance abuse and American Indians: prevalence and susceptibility. International Journal of the Addictions. 1982; 17:1185–1209. [PubMed: 6757155]

May PA. The epidemiology of alcohol abuse among American Indians: the mythical and real properties. American Indian Culture and Research Journal. 1994; 18:121–143.

May PA, Gossage JP. New data on the epidemiology of adult drinking and substance use among American Indians of the northern states: male and female data on prevalence, patterns, and consequences. American Indian and Alaska Native Mental Health Research. 2001; 10:1–26. [PubMed: 11698981]

McGue M, Iacono W, Legrand L, Malone S, Elkins I. Origins and consequences of age at first drink: associations with substance-use disorders, disinhibitory behavior and psychopathology, and P3 amplitude. Alcoholism: Clinical and Experimental Research. 2001; 25:1156–1165.

Miller KA, Beauvais F, Burnside M, Jumper-Thurman P. A comparison of American Indian and non-Indian fourth to sixth graders' rates of drug use. Journal of Ethnicity in Substance Abuse. 2008; 7:258–267. [PubMed: 19042809]

Mitchell CM, Beals J, Kaufman CE. The Pathways of Choice and Healthy Ways Project Team. Alcohol use, outcome expectancies, and HIV risk status among American Indian youth: a latent growth curve model with parallel processes. Journal of Youth and Adolescence. 2006; 35:729–740.

Mitchell CM, Beals J, Whitesell NR. Voices of Indian Teens Pathways of Choice Teams. Alcohol use among American Indian high school youth from adolescence and young adulthood: a latent Markov Model. Journal of Studies on Alcohol and Drugs. 2008; 69:666–675. [PubMed: 18781241]

Mitchell C, Novins D, Holmes T. Marijuana use among American Indian adolescents: a growth curve analysis from ages 14 through 20 years. Journal of the American Academy of Child and Adolescent Psychiatry. 1999; 38:72–78. [PubMed: 9893419]

Neumark-Sztainer D, Story M, French S, Cassido N, Jacobs D, Resnick M. Patterns of health-compromising behaviors among Minnesota adolescents: sociodemographic variations. American Journal of Public Health. 1996; 86:1599–1606. [PubMed: 8916527]

Novins D, Baron A. American Indian substance use: the hazards for substance use initiation and progression for adolescents aged 14 to 20 years. Journal of the American Academy of Child and Adolescent Psychiatry. 2004; 43:316–324. [PubMed: 15076265]

Novins DK, Mitchell CM. Factors associated with marijuana use among American Indian adolescents. Addiction. 1998; 93:1693–1702. [PubMed: 9926532]

O'Connell J, Novins D, Beals J, Spicer P. AI-SUPERPFP Team. Disparities in patterns of alcohol use among reservation-based and geographically dispersed American Indian populations. Alcoholism: Clinical and Experimental Research. 2005; 29I(1):107–116.

Plunkett M, Mitchell CM. Substance use rates among American Indian adolescents: regional comparisons with Monitoring the Future high school seniors. Journal of Drug Issues. 2000; 30:575–592.

Raudenbush, SW.; Bryk, AS. Hierarchical Linear Models: Applications and Data Analysis Methods. 2. Newbury Park, CA: Sage; 2002.

Roubideaux Y. Beyond Red Lake the persistent crisis in American Indian health care. The New England Journal of Medicine. 2005; 353:1881–1883. [PubMed: 16267317]

Snijders, T.; Bosker, RJ. Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling. Thousand Oaks, CA: Sage Publications; 1999.

Spear S, Longshore D, McCaffrey D, Ellikson P. Prevalence of substance use among white and American Indian young adolescents in a northern plains state. Journal of Psychoactive Drugs. 2005; 37:1–6. [PubMed: 15916246]

Substance Abuse and Mental Health Services Administration. Results from the 2009 National Survey on Drug Use and Health: Volume 1. Summary of National Findings. Rockville, MD: Office of Applies Studies; 2010.

Wallace JM, Bachman JG, O'Malley P, Schulenberg J, Cooper S, Johnston L. Gender and ethnic differences in smoking, drinking, and illicit drug use among Americans 8th, 10th, and 12th grade students, 1976–2000. Addiction. 2003; 98:225–234. [PubMed: 12534428]

Walls ML, Whitbeck L. Distress among indigenous North Americans: generalized and culturally relevant stressors. Society and Mental Health. 2011; 1:124–136. [PubMed: 22368789]

Walters K, Simoni J. Reconceptualizing Native women's health: an "indigenist" stress coping model. American Journal of Public Health. 2002; 90:344–351.

Walters KL, Simoni JM, Evans-Campbell T. Substance use among American Indians and Alaska Natives: incorporating culture in an "indigenist" stress-coping paradigm. Public Health Reports. 2002; 117(supplement 1):S104–S117. [PubMed: 12435834]

Westermeyer J. The drunken Indian: myths and realities. Psychiatric Annals. 1974; 4:29–36.

Whitesell NR, Beals J, Mithcell CM, Novins D, Spicer P, O'Connell J, Manson S. Marijuana initiation in 2 American Indian reservation communities: comparison with a national sample. American Journal of Public Health. 2007; 97:1311–1318. [PubMed: 17538072]

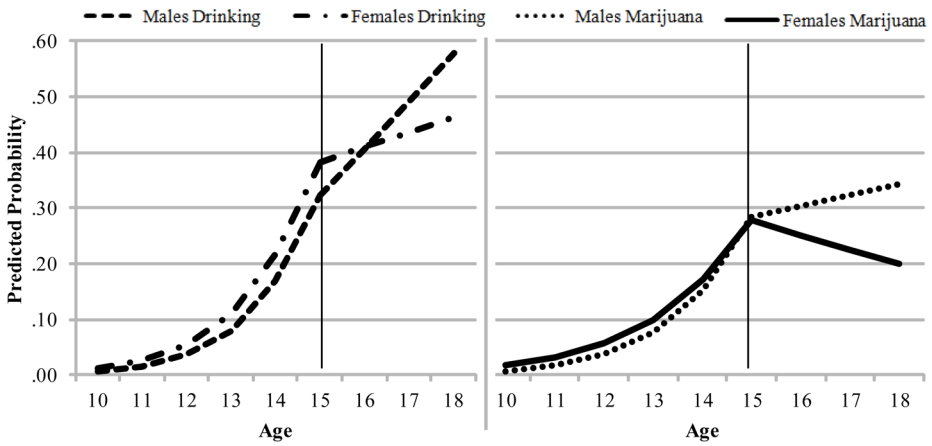

Figure 1. Expected growth in the probabilities of problem drinking and marijuana use, by gender

Note: Vertical line at age 15 denotes transition point between first and second growth trajectories

Table 1

Percent Adolescents Reporting Problem Drinking and Monthly Marijuana Use in the Past Year, by Cohort and Wave

	Cohort 1 (Age 10)			Cohort 2 (Age 11)			Cohort 3 (Age 12)		
Drinking	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
Wave 1	0.6	1.3	0.0	0.8	0.8	0.8	5.6	3.6	7.8
Wave 2	0.7	1.4	0.0	5.1	5.1	5.1	11.5	7.4	16.0
Wave 3	3.9	4.1	3.7	11.4	7.5	15.5	19.2	19.6	18.8
Wave 5	19.9	8.5	30.0	37.9	41.2	34.7	43.8	47.5	39.8
Wave 7	44.7	43.9	45.3	44.5	43.9	45.1	55.3	60.9	49.4
Marijuana	Total	Male	Female	Total	Male	Female	Total	Male	Female
Wave 1	0.6	1.3	0.0	0.8	0.0	1.6	4.2	2.7	5.9
Wave 2	0.6	1.4	0.0	5.1	4.2	5.9	15.2	9.2	21.8
Wave 3	3.2	4.1	2.4	10.5	8.4	12.7	21.1	19.6	22.7
Wave 5	15.4	15.5	15.4	29.6	33.6	25.6	25.8	27.7	23.7
Wave 7	27.0	30.3	24.0	28.5	30.8	26.3	27.4	34.8	19.5

Table 2

Piecewise HGLM Growth Curve Models of Problem Drinking (N=619)

	Model 1			Model 2			
Predictor	***B***	***OR***	***CI***	***B***	***OR***	***CI***	***Calc. OR[a]***
Fixed Effects							
Initial Status	−4.68***(.19)	0.01	0.00, 0.01	−4.99***(.33)	0.01	0.00, 0.01	
Female				.51(.40)	1.66	0.76, 3.64	
Income				−.11†(.05)	0.91	0.83, 1.00	
Remote				−.34(.65)	0.71	0.20, 2.55	
Growth before age 15	.83***(.04)	2.29	2.09, 2.51	.85***(.08)	2.34	1.99, 2.75	
Female				−.05(.10)	0.95	0.79, 1.16	2.23
Income				.01(.01)	1.01	0.99, 1.03	2.36
Remote				.18(.15)	1.19	0.89, 1.60	2.80
Growth after age 15	.23***(.05)	1.25	1.13, 1.39	.35***(.08)	1.42	1.22, 1.65	
Female				−.24*(.10)	0.79	0.79, 1.16	1.12
Income				.02(.01)	1.02	1.00, 1.05	1.45
Remote				−.03(.18)	0.97	0.68, 1.38	1.38
Random Effects							
Initial Status	1.21***			1.25***			

*** p<.001,

** p<.01,

* p<.05,

† p<.10

Note: Standard errors in parentheses.

[a] Odds ratio for cross-level interaction, the exponentiated sum of the level 2 B and the slope B.

Table 3

Piecewise HGLM Growth Curve Models of Marijuana Use (N=619)

	Model 1			Model 2			
Predictor	***B***	***OR***	***CI***	***B***	***OR***	***CI***	***Calc. OR[a]***
Fixed Effects							
Initial Status	−4.36***(.17)	0.01	0.01, 0.02	−4.87***(.27)	0.01	0.00, 0.01	
Female				.81*(.34)	2.25	1.17, 4.34	
Income				−.11*(.04)	0.90	0.83, 0.97	
Remote				−.25(.78)	0.78	0.15, 4.07	
Growth before age 15	.70***(.04)	2.02	1.86, 2.20	.79***(.07)	2.21	1.94, 2.53	
Female				−.17*(.09)	0.84	0.71, 1.00	1.86
Income				.01(.01)	1.01	0.99, 1.03	2.23
Remote				.19(.20)	1.21	0.82, 1.80	2.66
Growth after age 15	−.04(.05)	0.96	0.87, 1.07	.09(.07)	1.09	0.95, 1.26	
Female				−.23*(.11)	0.79	0.64, 0.98	0.87
Income				.01(.01)	1.01	0.99, 1.04	1.11
Remote				−.16(.18)	0.85	0.59, 1.23	0.93
Random Effects							
Initial Status	1.52***			1.59***			

*** p<.001,

** p<.01,

* p<.05,

† p<.10

Note: Standard errors in parentheses.

[a] Odds ratio for cross-level interaction, the exponentiated sum of the level 2 B and the slope B.